CLAIMS

We claim:

1. A method system for forming multiresolution wavelets comprising the steps of:

constructing isotropic ideal windows in a dimension greater than or equal to 1,

constructing translation and dilation operators adapted to form out of the ideal windows completely isotropic low pass filters, high pass filters and filters that cover a desired frequency range or plurality of frequency ranges from the isotropic ideal filters. into;

constructing filters from the ideal windows and the translation and dilation operators, where the filters are selected from the group consisting of low pass filters, high pass filters and filters that cover a desired frequency range or plurality of frequency ranges;

constructing isotropic scaling functions and associated translation operators for use with low pass scaling functions; and

producing associated wavelets from the filters and the scaling functions and low pass scaling functions adapted to resolve a multidimensional signal into various resolution levels.

2. The method of claim 1, further comprising the step of:

dividing each filter into at least one relative low pass component and at least one relative high pass components.

3. The method of claim 1, wherein the method is used in (i) data compression and storage for streaming video, seismic imaging, or digital medical imaging of all types, (ii) image and signal enhancement, denoising and analysis for medical imaging, seismic imaging, satellite imaging and surveillance, target acquisition, radar, sonar, or pattern recognition and analysis, (iii) volume rendering and segmentation, or motion analysis, and (iv) as a basis for digital algorithms for solving ordinary and partial differential equations in science, engineering, economics, and other disciplines.

3. A method system for analyzing data comprising the steps of:

constructing at least one wavelet including:

filters having at least one ideal window and necessary translation and dilation operators, where the filters are selected from the group consisting of low pass filters, high pass filters and filters that cover a desired frequency range or plurality of

frequency ranges;

isotropic scaling functions and associated translation operators for use with low pass scaling functions; and

resolving a multidimensional signal into various resolution levels with the at least one wavelet.

4. The method of claim 1, further comprising the step of:

dividing each filter into at least one relative low pass component and at least one relative high pass components.

5. The method of claim 1, wherein the method is used in (i) data compression and storage for streaming video, seismic imaging, or digital medical imaging of all types, (ii) image and signal enhancement, denoising and analysis for medical imaging, seismic imaging, satellite imaging and surveillance, target acquisition, radar, sonar, or pattern recognition and analysis, (iii) volume rendering and segmentation, or motion analysis, and (iv) as a basis for digital algorithms for solving ordinary and partial differential equations in science, engineering, economics, and other disciplines.

6. A system for processing signals implemented on a computer comprising:

a processing unit having encoded thereon a completely isotropic ideal filter for multiresolution analysis software including:

wavelets adapted to resolve a multidimensional signal into various resolution levels, where the wavelets are derived from:

isotropic ideal windows or filters in a dimension greater than or equal to 1,

translation and dilation constructs or operators adapted to form completely isotropic low pass filters, high pass filters and filters that cover a desired frequency range or plurality of frequency ranges from the isotropic ideal windows into; and

isotropic scaling functions and associated translation operators for use with low pass scaling function;

7. The system of claim 6, wherein each high pass and each low pass filter comprise:

at least one relative low pass component and at least one relative high pass component.

8. The system of claim 7, wherein each relative high pass component and each relative low pass filter comprise:

at least one relative low pass subcomponent and at least one relative high pass subcomponent.

9. The system of claim 6, wherein each high pass and each low pass filter comprise:

a plurality of high pass and low pass components, each component including at least one relative low pass subcomponent and at least one relative high pass subcomponent.

10. A completely isotropic, intrinsically non-separable low pass filter or high pass filter comprising:

isotropic ideal windows in a dimension greater than or equal to 1, and

translation and dilation operators adapted to form out of the ideal windows completely isotropic low pass filters, high pass filters and filters that cover a desired frequency range or plurality of frequency ranges from the isotropic ideal filters.

11. The filter of claim 10, wherein the low pass filter comprises:

$$m_0(\xi) = \sqrt{2}\chi_{D/\sqrt{2}}(\xi),\ \xi \in \mathbf{T}^2.$$

12. A completely isotropic, intrinsically non-separable scaling functions comprising:

$$\phi = F^{-1}(\chi_{D_r})$$

13. A wavelet scaling functions comprising:

$$\phi(R) = \frac{J_{n/2}(\pi R)}{(2R)^{n/2}}, \quad R > 0 \qquad (15)$$

14. A wavelet comprising:

at least one filter including at least one ideal window and translation and dilation operators, where the filters are selected from the group consisting of low pass filters, high pass filters and filters that cover a desired frequency range or plurality of frequency ranges; and

constructing isotropic scaling functions and associated translation operators for use with low pass scaling functions.

15. The filter of claim 14, wherein the wavelet further comprises:

$$h_r = e_{q_r}\chi_Q \quad r \in \{0,1,\ldots,p-1\} \tag{15}$$

where $\{e_{A(\mathbf{k})}h_r : \mathbf{k} \in \mathbf{Z}^n, r = 0,1,\ldots,p-1\}$ is a Parseval frame for $L^2(Q)$ and for $\hat{W}_{-1}$, $\{T_{A(\mathbf{k})}F^{-1}h_r : \mathbf{k} \in \mathbf{Z}^n, r = 0,1,\ldots,p-1\}$ is a Parseval frame for W_{-1}, $\psi_r = D\mathfrak{F}^{-1}h_r$ ($r = 0, 1, \ldots, p-1$), $\{T_{\mathbf{k}}\psi_r : \mathbf{k} \in Z^n, r = 0, 1, \ldots, p-1\}$ is a Parseval frame for W_0, and $\{\psi_r : r = 0, 1, \ldots, p-1\}$ is a Parseval frame multiwavelet set associated with the FMRA $\{V_j\}_j$.